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Appendix G. Technical Review Entrance and Success Criteria

This appendix describes the recommended best practices for entrance and success criteria for the technical reviews required in Chapter 5.

G.1 Program\System Requirements Review

The P/SRR is used to ensure that the program requirements are properly formulated and correlated with the Agency and mission directorate strategic objectives.

Table G-1 P/SRR Entrance and Success Criteria

Program/System Requirements Review	
Entrance Criteria	**Success Criteria**
1. A Formulation Authorization Document (FAD) has been approved. 2. Program requirements have been defined that support mission directorate requirements on the program. 3. Major program risks and corresponding mitigation strategies have been identified. 4. The high-level program requirements have been documented to include:	1. With respect to mission and science requirements, defined high-level program requirements are determined to be complete and are approved. 2. Defined interfaces with other programs are approved. 3. The program requirements are determined to provide a cost-effective program. 4. The program requirements are

a. performance, b. safety, and c. programmatic requirements. 5. An approach for verifying compliance with program requirements has been defined. 6. Procedures for controlling changes to program requirements have been defined and approved. 7. Traceability of program requirements to individual projects is documented in accordance with Agency needs, goals, and objectives, as described in the NASA Strategic Plan. 8. Top program/project risks with significant technical, safety, cost, and schedule impacts are identified.	adequately levied on either the single-program project or the multiple projects of the program. 5. The plans for controlling program requirement changes have been approved. 6. The approach for verifying compliance with program requirements has been approved. 7. The mitigation strategies for handling identified major risks have been approved.

G.2 Program/System Definition Review

The P/SDR applies to all NASA space flight programs to ensure the readiness of these programs to enter an approved Program Commitment Agreement (PCA). The approved PCA permits programs to transition from the program formulation phase to the program implementation phase. A Program Approval Review (PAR) is conducted as part of the P/SDR to provide Agency management with an independent assessment of the readiness of the program to proceed into implementation.

The P/SDR examines the proposed program architecture and the flow down to the functional elements of the system. The proposed program's objectives and the concept for meeting those objectives are evaluated. Key technologies and other risks are identified and assessed. The baseline Program Plan, budgets, and schedules are presented.

The technical team provides the technical content to support the P/SDR.

Table G-2 P/SDR Entrance and Success Criteria

Program/System Definition Review	
Entrance Criteria	**Success Criteria**
1. A Program/System Requirements Review has been satisfactorily completed. 2. A program plan has been prepared that includes the following: a. how the program will be managed; b. a list of specific projects; c. the high-level program requirements	1. An approved program plan and management approach. 2. Approved SEMP and technical approach. 3. Estimated costs are adequate. 4. Documentation for obtaining the Program Commitment Agreement is approved.

(including risk criteria);

d. performance, safety, and programmatic requirements correlated to Agency and directorate strategic objectives;

e. description of the systems to be developed (hardware and software), legacy systems, system interfaces, and facilities; and

f. identification of major constraints affecting system development (e.g., cost, launch window, required launch vehicle, mission planetary environment, engine design, international partners, and technology drivers).

3. Program level SEMP which includes project technical approaches and management plans to implement the allocated program requirements including constituent launch, flight, and ground systems, and operations and logistics concepts.

4. Independent Cost Analyses (ICAs) and Independent Cost Estimates (ICEs).

5. Management plan for resources other than budget.

6. Documentation for obtaining the program commitment agreement that includes the following:

a. the feasibility of the program mission solution with a cost estimate within acceptable cost range,

b. project plans adequate for project formulation initiation,

c. identified and prioritized program concept evaluation criteria to be used in project evaluations,

d. estimates of required annual funding levels,

e. credible program cost and schedule allocation estimates to projects,

5. An approved draft program control plan.

6. Agreement that the program is aligned with the Agency needs, goals and objectives.

7. The technical approach is adequate.

8. The schedule is adequate and consistent with cost, risk and mission goals.

9. Resources other than budget are adequate and available.

f. acceptable risk and mitigation strategies (supported by a technical risk assessment), g. organizational structures and defined work assignments, h. defined program acquisition strategies. i. interfaces to other programs and partners, j. a draft plan for program implementation, and k. a defined program management system. 7. A draft program control plan that includes: a. how the program plans to control program requirements, technical design, schedule, and cost to achieve its high-level requirements; b. how the requirements, technical design, schedule, and cost of the program will be controlled; c. how the program will utilize its technical, schedule, and cost reserves to control the baseline; d. how the program plans to report technical, schedule, and cost status to the MDAA, including frequency and the level of detail; and e. how the program will address technical waivers and how dissenting opinions will be handled. 8. For each project, a top-level description has been documented.	

G.3 Mission Concept Review

The MCR affirms the mission need and examines the proposed mission?s objectives and the concept for meeting those objectives.

Table G-3 MCR Entrance and Success Criteria

Mission Concept Review	
Entrance Criteria	**Success Criteria**
1. Mission goals and objectives. 2. Analysis of alternative concepts to show at least one is feasible. 3. Concept of operations. 4. Preliminary mission descope options. 5. Preliminary risk assessment, including technologies and associated risk management/mitigation strategies and options. 6. Conceptual test and evaluation strategy.	1. Mission objectives are clearly defined and stated and are unambiguous and internally consistent. 2. The preliminary set of requirements satisfactorily provides a system that will meet the mission objectives. 3. The mission is feasible. A solution has been identified that is technically feasible. A rough cost estimate is within an acceptable cost range. 4. The concept evaluation criteria to be used in candidate systems evaluation have

7. Preliminary technical plans to achieve next phase. 8. Defined MOEs and MOPs. 9. Conceptual life-cycle support strategies (logistics, manufacturing, and operation).	been identified and prioritized. 5. The need for the mission has been clearly identified. 6. The cost and schedule estimates are credible. 7. An updated technical search was done to identify existing assets or products that could satisfy the mission or parts of the mission. 8. Technical planning is sufficient to proceed to the next phase. 9. Risk and mitigation strategies have been identified and are acceptable based on technical risk assessments.

G.4 System Requirements Review

The SRR examines the functional and performance requirements defined for the system and the preliminary program or project plan and ensures that the requirements and the selected concept will satisfy the mission

Table G-4 SRR Entrance and Success Criteria

System Requirements Review	
Entrance Criteria	**Success Criteria**
1. Successful completion of the MCR and responses made to all MCR Requests for Actions (RFAs) and Review Item Discrepancies (RIDs). 2. A preliminary SRR agenda, success criteria, and charge to the board have been agreed to by the technical team, project manager, and review chair prior to the SRR. 3. The following technical products for hardware and software system elements are available to the cognizant participants prior to the review: a. system requirements document; b. system software functionality description;	1. The project utilizes a sound process for the allocation and control of requirements throughout all levels, and a plan has been defined to complete the definition activity within schedule constraints. 2. Requirements definition is complete with respect to top-level mission and science requirements, and interfaces with external entities and between major internal elements have been defined. 3. Requirements allocation and flow down of key driving requirements have been defined down to subsystems. 4. Preliminary approaches have been determined for how requirements will be verified and validated down to the

c. updated concept of operations; d. updated mission requirements, if applicable; e. baselined SEMP; f. risk management plan; g. preliminary system requirements allocation to the next lower level system; h. updated cost estimate; i. Technology Development Maturity Assessment Plan; j. updated risk assessment and mitigations (including PRA as applicable). k. logistics documentation (e.g., preliminary maintenance plan); l. preliminary human rating plan, if applicable; m. Software Development Plan (SDP); n. system safety and mission assurance plan; o. configuration management plan; p. initial document tree; q. verification and validation approach; r. preliminary system safety analysis; and s. other specialty disciplines, as required.	subsystem level. 5. Major risks have been identified and technically assessed, and viable mitigation strategies have been defined.

G.5 Mission Definition Review

The MDR examines the proposed requirements, the mission architecture, and the flow down to all functional elements of the mission to ensure that the overall concept is complete, feasible, and consistent with available resources.

Table G-5 MDR Entrance and Success Criteria

Mission Definition Review	
Entrance Criteria	**Success Criteria**

1. Successful completion of the SRR and responses made to all SRR RFAs and RIDs. 2. A preliminary MDR agenda, success criteria, and charge to the board have been agreed to by the technical team, project manager, and review chair prior to the MDR. 3. The following technical products for hardware and software system elements are available to the cognizant participants prior to the review: a. system architecture; b. updated system requirements document, if applicable; c. system software functionality description; d. updated concept of operations, if applicable; e. updated mission requirements, if applicable; f. updated SEMP, if applicable; g. updated risk management plan, if applicable; h. Technology Development Maturity Assessment Plan; i. preferred system solution definition, including major trades and options; j. updated risk assessment and mitigations (including PRA, as applicable); k. updated cost and schedule data; l. logistics documentation (e.g., preliminary maintenance plan); m. Software Development Plan (SDP); n. system safety and mission assurance plan; o. configuration management plan;	1. The resulting overall concept is reasonable, feasible, complete, responsive to the mission requirements, and is consistent with system requirements and available resources (cost, schedule, mass, and power). 2. System and subsystem design approaches and operational concepts exist and are consistent with the requirements set. 3. The requirements, design approaches, and conceptual design will fulfill the mission needs within the estimated costs. 4. Major risks have been identified and technically assessed, and viable mitigation strategies have been defined.

p. updated initial document tree, if applicable; q. preliminary system safety analysis; and r. other specialty disciplines as required.	

G.6 SystemDefinition Review

The SDR examines the proposed system architecture and design and the flow down to all functional elements of the system.

Table G-6 SDR Entrance and Success Criteria

System Definition Review	
Entrance Criteria	**Success Criteria**
1. Successful completion of the SRR and responses made to all SRR RFAs and RIDs. 2. A preliminary SDR agenda, success criteria, and charge to the board have been agreed to by the technical team, project manager, and review chair prior to the SDR. 3. SDR technical products listed below for both hardware and software system elements have been made available to the cognizant participants prior to the review: a. system architecture; b. preferred system solution definition including major tradeoffs and options; c. updated baselined documentation, as required; d. preliminary functional baseline (with supporting trade-off analyses and data); e. preliminary system software functional requirements; f.SEMP changes, if any; g. updated risk management plan; h. updated risk assessment and mitigations (including PRA, as applicable); i. updated technology development, maturity, and assessment plan; j. updated cost and schedule data; k. updated logistics documentation; l. based on system complexity, updated human rating plan; m. software test plan; n. software requirements document(s); o. interface requirements documents (including software);	1. Systems requirements, including mission success criteria and any sponsor-imposed constraints, are defined and form the basis for the proposed conceptual design. 2. All technical requirements are allocated and the flow down to subsystems is adequate. The requirements, design approaches, and conceptual design will fulfill the mission needs consistent with the available resources (cost, schedule, mass, and power). 3. The requirements process is sound and can reasonably be expected to continue to identify and flow detailed requirements in a manner timely for development. 4. The technical approach is credible and responsive to the identified requirements. 5. Technical plans have been updated, as necessary. 6. The tradeoffs are completed, and those planned for Phase B adequately address the option space. 7. Significant development, mission, and safety risks are identified and technically assessed, and a process and resources exist to manage the risks. 8. Adequate planning exists for the development of any enabling new technology. 9. The operations concept is consistent with proposed design concept(s) and is in alignment with the mission requirements.

p. technical resource utilization estimates and margins; q. updated safety and mission assurance (S&MA) plan; and r.updated preliminary safety analysis.	

G.7 Preliminary Design Review

The PDR demonstrates that the preliminary design meets all system requirements with acceptable risk and within the cost and schedule constraints and establishes the basis for proceeding with detailed design. It will show that the correct design options have been selected, interfaces have been identified, and verification methods have been described.

Table G-7 PDR Entrance and Success Criteria

Preliminary Design Review	
Entrance Criteria	**Success Criteria**
1. Successful completion of the SDR or MDR and responses made to all SDR or MDR RFAs and RIDs, or a timely closure plan exists for those remaining open. 2. A preliminary PDR agenda, success criteria, and charge to the board have been agreed to by the technical team, project manager, and review chair prior to the PDR. 3. PDR technical products listed below for both hardware and software system elements have been made available to the cognizant participants prior to the review: a. Updated baselined documentation, as required. b. Preliminary subsystem design specifications for each configuration item (hardware and software), with supporting trade-off analyses and data, as required. The preliminary software design specification should include a completed definition of the software architecture and a preliminary database design description, as applicable. c. Updated technology development maturity assessment plan. d. Updated risk assessment and mitigation. e. Updated cost and schedule data. f. Updated logistics documentation, as	1. The top-level requirements including mission success criteria, TPMs, and any sponsor-imposed constraints are agreed upon, finalized, stated clearly, and consistent with the preliminary design. 2. The flow down of verifiable requirements is complete and proper or, if not, an adequate plan exists for timely resolution of open items. Requirements are traceable to mission goals and objectives. 3. The preliminary design is expected to meet the requirements at an acceptable level of risk. 4. Definition of the technical interfaces is consistent with the overall technical maturity and provides an acceptable level of risk. 5. Adequate technical interfaces are consistent with the overall technical maturity and provide an acceptable level of risk. 6. Adequate technical margins exist with respect to TPMs. 7. Any required new technology has been developed to an adequate state of readiness, or back-up options exist

required. g. Applicable technical plans (e.g., technical performance measurement plan, contamination control plan, parts management plan, environments control plan, EMI/EMC control plan, payload-to-carrier integration plan, producibility/manufacturability program plan, reliability program plan, quality assurance plan). h. Applicable standards. i. Safety analyses and plans. j. Engineering drawing tree. k. Interface control documents. l. Verification/validation plan. m. Plans to respond to regulatory requirements (e.g., Environmental Impact Statement), as required. n. Disposal plan. o. Technical resource utilization estimates and margins. p. System-level safety analysis. q. Preliminary limited life items list (LLIL).	and are supported to make them a viable alternative. 8. The project risks are understood and have been credibly assessed, and plans, a process, and resources exist to effectively manage them. 9. Safety and mission assurance (e.g., safety, reliability, maintainability, quality, and EEE parts) have been adequately addressed in preliminary designs and any applicable S&MA products (e.g., PRA, system safety analysis, and failure modes and effects analysis) have been approved. 10. The operational concept is technically sound, includes (where appropriate) human factors, and includes the flow down of requirements for its execution.

G.8 Critical Design Review

The CDR demonstrates that the maturity of the design is appropriate to support proceeding with full-scale fabrication, assembly, integration, and test. CDR determines that the technical effort is on track to complete the flight and ground system development and mission operations, meeting mission performance requirements within the identified cost and schedule constraints.

Table G-8 CDR Entrance and Success Criteria

Critical Design Review	
Entrance Criteria	**Success Criteria**
1. Successful completion of the PDR and responses made to all PDR RFAs and RIDs, or a timely closure plan exists for those remaining open. 2. A preliminary CDR agenda, success criteria, and charge to the board have been agreed to by the technical team, project manager, and review chair prior to the CDR.	1. The detailed design is expected to meet the requirements with adequate margins at an acceptable level of risk. 2. Interface control documents are sufficiently matured to

3. CDR technical work products listed below for both hardware and software system elements have been made available to the cognizant participants prior to the review: a. updated baselined documents, as required; b. product build-to specifications for each hardware and software configuration item, along with supporting trade-off analyses and data; c. fabrication, assembly, integration, and test plans and procedures; d. technical data package (e.g., integrated schematics, spares provisioning list, interface control documents, engineering analyses, and specifications); e. operational limits and constraints; f. technical resource utilization estimates and margins; g. acceptance criteria; h. command and telemetry list; i. verification plan (including requirements and specification); j. validation plan; k. launch site operations plan; l. checkout and activation plan; m. disposal plan (including decommissioning or termination); n. updated Technology Development Maturity Assessment Plan; o. updated risk assessment and mitigation; p. updated reliability analyses and assessments; q. updated cost and schedule data; r. updated logistics documentation; s. software design document(s) (including interface design documents); t. updated LLIL;	proceed with fabrication, assembly, integration, and test, and plans are in place to manage any open items. 3. High confidence exists in the product baseline, and adequate documentation exists or will exist in a timely manner to allow proceeding with fabrication, assembly, integration, and test. 4. The product verification and product validation requirements and plans are complete. 5. The testing approach is comprehensive, and the planning for system assembly, integration, test, and launch site and mission operations is sufficient to progress into the next phase. 6. Adequate technical and programmatic margins and resources exist to complete the development within budget, schedule, and risk constraints. 7. Risks to mission success are understood and credibly assessed, and plans and resources exist to effectively manage them. 8. Safety and mission assurance (e.g., safety, reliability, maintainability, quality, and EEE parts) have been adequately addressed in system and operational designs, and any applicable S&MA products (e.g., PRA, system safety analysis and failure modes and effects analysis) have been approved.

u. subsystem-level and preliminary operations safety analyses; v. systems and subsystem certification plans and requirements (as needed); and w. system safety analysis with associated verifications.	

G.9 Production Readiness Review

A PRR is held for FS&GS projects developing or acquiring multiple or similar systems greater than three or as determined by the project. The PRR determines the readiness of the system developers to efficiently produce the required number of systems. It ensures that the production plans; fabrication, assembly, and integration enabling products; and personnel are in place and ready to begin production.

Table G-9 PRR Entrance and Success Criteria

Production Readiness Review	
Entrance Criteria	**Success Criteria**
1. The significant production engineering problems encountered during development are resolved. 2. The design documentation is adequate to support production. 3. The production plans and preparation are adequate to begin fabrication. 4. The production-enabling products and adequate resources are available, have been allocated, and are ready to support end product production.	1. The design is appropriately certified. 2. The system requirements are fully met in the final production configuration. 3. Adequate measures are in place to support production. 4. Design-for-manufacturing considerations ensure ease and efficiency of production and assembly. 5. Risks have been identified, credibly assessed, and characterized, and mitigation efforts have been defined. 6. The bill of materials has been reviewed and critical parts identified. 7. Delivery schedules have been verified. 8. Alternate sources for resources have been identified, as appropriate. 9. Adequate spares have been planned and budgeted. 10. Required facilities and tools are sufficient for end product production. 11. Specified special tools and test equipment are available in proper quantities. 12. Production and support staff are qualified. 13. Drawings are certified. 14. Production engineering and planning are sufficiently mature for cost-effective production. 15. Production processes and methods are consistent with quality requirements and compliant with occupational safety, environmental, and energy conservation regulations. 16. Qualified suppliers are available for materials that are to be procured.

G.10 System Integration Review

An SIR ensures that the system is ready to be integrated. Segments, components, and subsystems are available and ready to be integrated into the system. Integration facilities, support personnel, and integration plans and procedures are ready for integration.

Table G-10 SIR Entrance and Success Criteria

System Integration Review	
Entrance Criteria	**Success Criteria**
1. Integration plans and procedures have been completed and approved. 2. Segments and/or components are available for integration. 3. Mechanical and electrical interfaces have been verified against the interface control documentation. 4. All applicable functional, unit-level, subsystem, and qualification testing has been conducted successfully. 5. Integration facilities, including clean rooms, ground support equipment, handling fixtures, overhead cranes, and electrical test equipment, are ready and available. 6. Support personnel have been adequately trained. 7. Handling and safety requirements have been documented. 8. All known system discrepancies have been identified and disposed in accordance with an agreed-upon plan. 9. All previous design review success criteria and key issues have been satisfied in accordance with an agreed-upon plan. 10. The quality control organization is ready to support the integration effort.	1. Adequate integration plans and procedures are completed and approved for the system to be integrated. 2. Previous component, subsystem, and system test results form a satisfactory basis for proceeding to integration. 3. Risk level is identified and accepted by program/project leadership, as required. 4. The integration procedures and work flow have been clearly defined and documented. 5. The review of the integration plans, as well as the procedures, environment, and configuration of the items to be integrated, provides a reasonable expectation that the integration will proceed successfully. 6. Integration personnel have received appropriate training in the integration and safety procedures.

G.11 Test Readiness Review

A TRR ensures that the test article (hardware/software), test facility, support personnel, and test procedures are ready for testing and data acquisition, reduction, and control. This is not a prerequisite for KDP E.

Table G-11 TRR Entrance and Success Criteria

Test Readiness Review	
Entrance Criteria	**Success Criteria**
1. The objectives of the testing have been clearly defined and documented, and all of the test plans, procedures, environment, and configuration of the test item(s) support those objectives. 2. Configuration of the system under test has been defined and agreed to. All interfaces have been placed under configuration management or have been defined in accordance with an agreed to plan, and a version description document has been made available to TRR participants prior to the review. 3. All applicable functional, unit-level, subsystem, system, and qualification testing has been conducted successfully. 4. All TRR-specific materials, such as test plans, test cases, and procedures, have been available to all participants prior to conducting the review. 5. All known system discrepancies have been identified and disposed in accordance with an agreed-upon plan. 6. All previous design review success criteria and key issues have been satisfied in accordance with an agreed-upon plan. 7. All required test resources people (including a designated test director), facilities, test articles, test instrumentation, and other test enabling products have been identified and are available to support required tests. 8. Roles and responsibilities of all test participants are defined and agreed to. 9. Test contingency planning has been accomplished, and all personnel have been trained.	1. Adequate test plans are completed and approved for the system under test. 2. Adequate identification and coordination of required test resources are completed. 3. Previous component, subsystem, and system test results form a satisfactory basis for proceeding into planned tests. 4. Risk level is identified and accepted by program/competency leadership as required. 5. Plans to capture any lessons learned from the test program are documented. 6. The objectives of the testing have been clearly defined and documented, and the review of all the test plans, as well as the procedures, environment, and configuration of the test item, provide a reasonable expectation that the objectives will be met. 7. The test cases have been reviewed and analyzed for expected results, and the results are consistent with the test plans and objectives. 8. Test personnel have received appropriate training in test operation and safety procedures.

G.12 System Acceptance Review

The SAR verifies the completeness of the specific end products in relation to their expected maturity level and assesses compliance to stakeholder expectations. The SAR examines the system, its end products and documentation, and test data and analyses that support verification. It also ensures that the system has sufficient technical maturity to authorize its shipment to the designated operational facility or launch site.

Table G-12 SAR Entrance and Success Criteria

System Acceptance Review	
Entrance Criteria	**Success Criteria**
1. A preliminary agenda has been coordinated (nominally) prior to the SAR. 2. The following SAR technical products have been made available to the cognizant participants prior to the review: a. results of the SARs conducted at the major suppliers; b. transition to production and/or manufacturing plan; c. product verification results; d. product validation results; e. documentation that the delivered system complies with the established acceptance criteria; f. documentation that the system will perform properly in the expected operational environment; g. technical data package updated to include all test results; h. certification package; i. updated risk assessment and mitigation; j. successfully completed previous milestone reviews; and k. remaining liens or unclosed actions and plans for closure.	1. Required tests and analyses are complete and indicate that the system will perform properly in the expected operational environment. 2. Risks are known and manageable. 3. System meets the established acceptance criteria. 4. Required safe shipping, handling, checkout, and operational plans and procedures are complete and ready for use. 5. Technical data package is complete and reflects the delivered system. 6. All applicable lessons learned for organizational improvement and system operations are captured.

G.13 Operational Readiness Review

The ORR examines the actual system characteristics and the procedures used in the system or end product?s operation and ensures that all system and support (flight and ground) hardware, software, personnel, procedures, and user documentation accurately reflect the deployed state of the system.

Table G-13 ORR Entrance and Success Criteria

Operational Readiness Review	
Entrance Criteria	**Success Criteria**
1. All validation testing has been completed. 2. Test failures and anomalies from validation testing have been resolved and the results incorporated into all supporting and enabling operational products. 3. All operational supporting and enabling products (e.g., facilities, equipment, documents, updated databases) that are necessary for the nominal and contingency operations have been tested and delivered/installed at the site(s) necessary to support operations. 4. Operations handbook has been approved. 5. Training has been provided to the users and operators on the correct operational procedures for the system. 6. Operational contingency planning has been accomplished, and all personnel have been trained.	1. The system, including any enabling products, is determined to be ready to be placed in an operational status. 2. All applicable lessons learned for organizational improvement and systems operations have been captured. 3. All waivers and anomalies have been closed. 4. Systems hardware, software, personnel, and procedures are in place to support operations.

G.14 Flight Readiness Review

The FRR examines tests, demonstrations, analyses, and audits that determine the system?s readiness for a safe and successful flight or launch and for subsequent flight operations. It also ensures that all flight and ground hardware, software, personnel, and procedures are operationally ready.

Table G-14 FRR Entrance and Success Criteria

Flight Readiness Review	
Entrance Criteria	**Success Criteria**
1. Certification has been received that flight operations can safely proceed with acceptable risk. 2. The system and support elements have been confirmed as properly configured and ready for flight. 3. Interfaces are compatible and function as expected. 4. The system state supports a launch "go" decision based on go/no-go criteria. 5. Flight failures and anomalies from previously completed flights and reviews have been resolved and the results incorporated into all supporting and enabling operational products. 6. The system has been configured for flight.	1. The flight vehicle is ready for flight. 2. The hardware is deemed acceptably safe for flight (i.e., meeting the established acceptable risk criteria or documented as being accepted by the PM and DGA). 3. Flight and ground software elements are ready to support flight and flight operations. 4. Interfaces are checked and found to be functional. 5. Open items and waivers have been examined and found to be acceptable. 6. The flight and recovery environmental factors are within constraints. 7. All open safety and mission risk items have been addressed.

G.15 Post-Launch Assessment Review

A PLAR is a post-deployment evaluation of the readiness of the spacecraft systems to proceed with full, routine operations. The review evaluates the status, performance, and capabilities of the project evident from the flight operations experience since launch. This can also mean assessing readiness to transfer responsibility from the development organization to the operations organization. The review also evaluates the status of the project plans and the capability to conduct the mission with emphasis on near-term operations and mission-critical events. This review is typically held after the early flight operations and initial checkout.

Table G-15 PLAR Entrance and Success Criteria

Post-Launch Assessment Review	
Entrance Criteria	**Success Criteria**
1. The launch and early operations performance, including (when appropriate) the early propulsive maneuver results, are available. 2. The observed spacecraft and science instrument performance, including instrument calibration plans and status, are available. 3. The launch vehicle performance assessment and mission implications, including launch sequence assessment, launch operations experience with lessons learned, are completed. 4. The mission operations and ground data system experience, including tracking and data acquisition support and spacecraft telemetry data analysis, is available. 5. The mission operations organization, including status of staffing, facilities, tools, and mission software (e.g., spacecraft analysis, and sequencing), is available.	1. The observed spacecraft and science payload performance agrees with prediction, or if not, is adequately understood so that future behavior can be predicted with confidence. 2. All anomalies have been adequately documented, and their impact on operations assessed. Further, anomalies impacting spacecraft health and safety or critical flight operations have been properly disposed. 3. The mission operations capabilities, including staffing and plans, are adequate to

6. In-flight anomalies and the responsive actions taken, including any autonomous fault protection actions taken by the spacecraft or any unexplained spacecraft telemetry, including alarms, are documented. 7. The need for significant changes to procedures, interface agreements, software, and staffing has been documented. 8. Documentation is updated, including any updates originating from the early operations experience. 9. Future development/test plans are developed.	accommodate the actual flight performance. 4. Liens, if any, on operations, identified as part of the ORR, have been satisfactorily disposed.

G.16 Critical Event Readiness Review

A CERR confirms the project?s readiness to execute the mission?s critical activities during flight operation.

Table G-16 CERR Entrance and Success Criteria

Critical Event Readiness Review	
Entrance Criteria	**Success Criteria**
1. Mission overview and context for the critical event(s). 2. Activity requirements and constraints. 3. Critical activity sequence design description including key tradeoffs and rationale for selected approach. 4. Fault protection strategy. 5. Critical activity operations plan including planned uplinks and criticality. 6. Sequence verification (testing, walk-throughs, peer review) and critical activity validation. 7. Operations team training plan and readiness report. 8. Risk areas and mitigations. 9. Spacecraft readiness report. 10. Open items and plans.	1. The critical activity design complies with requirements. 2. The preparation for the critical activity, including the verification and validation, is thorough. 3. The project (including all the systems, supporting services, and documentation) is ready to support the activity. 4. The requirements for the successful execution of the critical event(s) are complete and understood and have flowed down to the appropriate levels for implementation.

G.17 Post-Flight Assessment Review

The PFAR evaluates the activities from the flight after recovery. The review identifies all anomalies that occurred during the flight and mission and determines the actions necessary to mitigate or resolve the anomalies for future flights.

Table G-17 PFAR Entrance and Success Criteria

Post-Flight Assessment Review	
Entrance Criteria	**Success Criteria**
1. All anomalies that occurred during the mission, as well as during preflight testing, countdown, and ascent, identified. 2. Report on overall post-recovery condition. 3. Report any evidence of ascent debris. 4. All photo and video documentation available. 5. Retention plans for scrapped hardware completed. 6. Post-Flight Assessment Team Operating Plan completed. 7. Disassembly activities planned and scheduled. 8. Processes and controls to coordinate in-flight anomaly trouble shooting and post-flight data preservation developed. 9. Problem reports, corrective action requests, Post Flight Anomaly Records (PFARs), and final post-flight documentation completed. 10. All post-flight hardware and flight data evaluation reports completed.	1. Formal final report documenting flight performance and recommendations for future missions. 2. All anomalies have been adequately documented and dispositioned. 3. The impact of anomalies on future flight operations has been assessed. 4. Plans for retaining assessment documentation and imaging have been made. 5. Reports and other documentation have been added to a database for performance comparison and trending.

G.18 Decommissioning Review

A DR confirms the decision to terminate or decommission the system and assesses the readiness of the system for the safe decommissioning and disposal of system assets.

Table G-18 DR Entrance and Success Criteria

Decommissioning Review	
Entrance Criteria	**Success Criteria**
1. Requirements associated with decommissioning and disposal are defined. 2. Plans are in place for decommissioning, disposal, and any other removal from service activities. 3. Resources are in place to support decommissioning and disposal activities, plans for disposition of project assets, and archival of essential mission and project data. 4. Safety, environmental, and any other constraints are described. 5. Current system capabilities are described. 6. For off-nominal operations, all contributing events, conditions, and changes to the originally expected baseline are described.	1. The reasons for decommissioning disposal are documented. 2. The decommissioning and disposal plan is complete, approved by appropriate management, and compliant with applicable Agency safety, environmental, and health regulations. Operations plans for all potential scenarios, including contingencies, are complete and approved. All required support systems are available. 3. All personnel have been properly trained for the nominal and contingency procedures. 4. Safety, health, and environmental hazards have been identified. Controls have been verified. 5. Risks associated with the disposal have been identified and adequately mitigated. Residual risks have been accepted by the required management. 6. If hardware is to be recovered from orbit: a. Return site activity plans have been defined and approved. b. Required facilities are available and meet requirements, including those for contamination control, if needed. c. Transportation plans are defined and approved. Shipping containers and handling equipment, as well as contamination and environmental control and monitoring devices, are available. 7. Plans for disposition of mission-owned assets (i.e., hardware, software, and facilities) have been defined and approved. 8. Plans for archival and subsequent analysis of mission data have been defined and approved. Arrangements have been finalized for the execution of such plans. Plans for the capture and dissemination of appropriate lessons learned during the project life cycle have been defined and approved. Adequate resources (schedule, budget, and staffing) have been identified and are available to successfully complete all decommissioning, disposal, and disposition activities. 9. Plans for transition of personnel have been defined and approved.

G.19 Periodic Technical Review

a. Science and technology development conducted by NASA in BAR, ATD, and IP programs and projects may not be conducted along the same rigorous processes and schedules as FS&GS programs. Depending on the scope and technology readiness level (TRL) of these projects, a streamlined review system may be appropriate. Sound engineering of processes defined in this SE NPR should be applied and reviewed, when appropriate. A PTR review schedule with well defined review entrance and success criteria should be developed in project formulation. Success criteria should ascertain whether sufficient technical maturity has been achieved to support a management decision to proceed to the next phase. In some cases, such as high TRL development efforts, a subset of FS&GS reviews is appropriate (e.g.,

SRR, PDR, CDR, SAR). PTRs should include both internal and independent external reviewers. Findings and actions from each PTR should be disseminated and resolved after each review.

b. NASA uses TRLs to measure the maturity of a technology. TRLs provide one metric for determining risk associated with the insertion of new technology. TRLs are shown in Table G-19. A TRL of 6 (technology demonstrated in a relevant environment) is desirable prior to integrating a new technology.

Table G-19 Technology Readiness Levels

	Technology Readiness Level	**Description**
1	Basic principles observed and reported.	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include paper studies of a technology?s basic properties.
2	Technology concept and/or application formulated.	Invention begins. Once basic principles are observed, practical applications can be invented. The application is speculative, and there is no proof or detailed analysis to support the assumption. Examples are still limited to paper studies.
3	Analytical and experimental critical function and/or characteristic proof of concept.	At this step in the maturation process, active research and development (R&D) is initiated. This must include both analytical studies to set the technology into an appropriate context and laboratory-based studies to physically validate that the analytical predictions are correct. These studies and experiments should constitute "proof-of-concept" validation of the applications/concepts formulated at TRL 2.
4	Component and/or breadboard validation in laboratory environment.	Following successful "proof-of-concept" work, basic technological elements must be integrated to establish that the pieces will work together to achieve concept-enabling levels of performance for a component and/or breadboard. This validation must be devised to support the concept that was formulated earlier and should also be consistent with the requirements of potential system applications. The validation is relatively "low-fidelity" compared to the eventual system: it could be composed of ad hoc discrete components in a laboratory.
5	Component and/or breadboard validation in relevant environment.	At this level, the fidelity of the component and/or breadboard being tested has to increase significantly. The basic technological elements must be integrated with reasonably realistic supporting elements so that the total applications (component-level, subsystem-level, or system-level) can be tested in a "simulated" or somewhat realistic environment.
6	System/subsystem model	A major step in the level of fidelity of the technology

	or prototype demonstration in a relevant environment.	demonstration follows the completion of TRL 5. At TRL 6, a representative model or prototype system or system, which would go well beyond ad hoc, "patch-cord," or discrete component level breadboarding, would be tested in a relevant environment. At this level, if the only relevant environment is the environment of space, then the model or prototype must be demonstrated in space.
7	System prototype demonstration in an operational environment.	Prototype near or at planned operational system. TRL 7 is a significant step beyond TRL 6, requiring an actual system prototype demonstration in a space environment. The prototype should be near or at the scale of the planned operational system, and the demonstration must take place in space. Examples include testing the prototype in a test bed.
8	Actual system competed and "flight qualified" through test and demonstration.	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this level is the end of true system development for most technology elements. This might include integration of new technology into an existing system.
9	Actual system flight proven through successful mission operations	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation. In almost all cases, this is the end of the last "bug fixing" aspects of true system development. This TRL does not include planned product improvement of ongoing or reusable systems.

Source: Mankins (1995), "Technology Readiness Levels: A White Paper."

G.20 Technical Peer Reviews

a. Peer reviews provide the technical insight essential to ensure product and process quality. Peer reviews are focused, in-depth technical reviews that support the evolving design and development of a product, including critical documentation or data packages. They are often, but not always, held as supporting reviews for technical reviews such as PDR and CDR. A purpose of the peer review is to add value and reduce risk through expert knowledge, infusion, confirmation of approach, identification of defects, and specific suggestions for product improvements.

b. The results of the engineering peer reviews (EPRs) comprise a key element of the review process. The results and issues that surface during these reviews are documented and reported at the appropriate next higher element level.

c. The peer reviewers should be selected from outside the project, but they should have a similar technical background, and they should be selected for their skill and experience. Peer reviewers should be concerned with only the technical integrity and quality of the product. Peer reviews should be kept simple and informal. They should concentrate on a review of the documentation and minimize viewgraph presentations. A round-table format rather than a stand-up presentation is preferred. The peer reviews should give the full technical picture of items being reviewed.

d. Technical depth should be established at a level that allows the review team to gain insight into the technical risks. Rules should be established to ensure consistency in the peer review process. At the conclusion of the review, a report on the findings and actions must be distributed.

e. Peer reviews must be part of the contract for those projects where systems engineering is done out-of-house.

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